

REMARKS

Claims 1-10 are active in the case. Reconsideration is respectfully requested.

The present invention relates to a process for producing an absorption layer for a solar cell.

Specification Amendments, 35 USC 112

The specification has been amended on page 7 in two separate paragraphs in order to resolve the issues raised by the Examiner under 112 involving the expression of language in each of the paragraphs. The language changes which have been made are believed sufficient in order to overcome the issues of lack of clarity that have been raised. No new matter is believed to have been added to the specification. Entry of the amendment is respectfully requested.

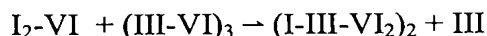
Claim Amendments, 35 USC 112

In considering the issues that have been raised under 35 USC 112, applicants submit that it is helpful to consider these issues in light of background information of the present invention.

The MOCVD process of producing a thin film of an I-III-VI compound is very complex and involves a series of gas and surface reactions. The process can be divided into several steps of:

- (1) evaporation and transport of reagents and precursors;
- (2) pyrolysis of precursors which lead to deposition of the semiconductor materials;
- (3) surface chemical reactions which lead to film deposition and to by-products which subsequently desorb; and
- (4) mass transport of by-products into the bulk gas flow region and out of the reactor.

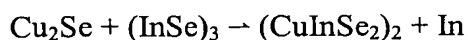
In the process an InSe thin film is produced using an InSe single source precursor. A Cu precursor is thereafter provided which leads to the dissolution by substrate heat energy and deposition of the Cu. Cu is absorbed on the surface by being inter-diffused in InSe, thereby forming a chemical compound. Although it depends on temperature, a considerable amount of In atoms combines with a ligand that is released from the Cu precursor. Desorption of the In material occurs. By this means sometimes a thin film of deposited InSe changes into a thin film of Cu₂Se, or a thin film of CuInSe₂ may form with only the In-Se precursor without the addition of Se material at this stage of film formation. If the method of product film production is conducted such that a single source precursor of atoms of a group III element and atoms of a group VI element are deposited on a thin film where a I₂-VI compound has been formed, then a thin film of a I-III-VI₂ compound is formed. (As used in the present invention, a "single source precursor does not mean that all three element components of groups I, III and VI are present, but rather means a precursor that includes elements of groups III and VI.) The equation that describes this reaction is as follows:



It is clear from the equation that even though element III is produced as a product in the reaction, a thin film of I-III-VI₂ nevertheless, is formed. The liberated group III element is eliminated from the thin film and flows into the vacuum of the reactor system. Claims 1 to 3 have been amended in a fashion which is believed sufficient to clarify the meaning of the groups of the Periodic Table taken from Groups IB, IIIB and VIB of the Table to form the embodiments of absorption layers of the present invention. (It is noted that the cited Beck et al patent uses group symbols from the Periodic Table in order to define the compounds within the disclosure.) None of the amendments are believed to have introduced new matter into the case. Accordingly, in order to produce a I-III-VI₂ compound, a single source precursor and a I precursor are required.

As to the issue that has been raised with respect to Claims 4-8, it is believed that the amendments made to Claims 1-3 in clarifying the meaning of these claims now make the antecedent basis for Claims 4-8 in Claims 1-3 clear. The precursors of the dependent claims find clear basis in Claims 1-3.

With respect to Claim 9, when a thin film of Cu_2Se compound is formed and a single source precursor of In and Se is deposited as a InSe film on the Cu_2Se film, a thin film of a I-III-VI₂ is formed with the release of In as shown in the following equation.



Even though one atom of In is released in the reaction, a thin film of CuInSe_2 is nevertheless formed in the decomposition reaction and flows into the vacuum system of the reactor. In view of the foregoing explanation it is clear that the Claim 9 does not describe a process in which only a single precursor compound of group III and group VI elements is involved in the reaction. Claim 9 clearly calls for the formation of a film of Cu_2Se on a film of InSe . The result is a product film of CuInSe_2 . Again, it is important to bear in mind that the phrase "single precursor compound" does not mean that all three element components of groups I, III and VI are present, but rather means a precursor that includes elements of groups III and VI.) Accordingly, the meaning of the claims is definite.

As to the issue of Claim 10, since the process step of Claim 10 is dependent on the three step process of Claim 9 by which a thin film of CuInSe_2 is formed, Claim 10 therefore fully incorporates the process of Claim 9 therein. The process of Claim 9 is modified by the process step of Claim 10 by the additional modification that a single precursor material containing Ga and Se interacts with the CuInSe_2 film to form the thin film of $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$. The language of Claim 10 is accurate in positing a thin film of $\text{CuIn}_{1-x}\text{Ga}_x\text{Se}_2$.

Second Paragraph, 35 USC 112

As to the matter of the questions concerning subscript "x" in Claim 7, the value of the subscript ranges from zero to less than 1 so that subscript simply indicates the amount of added element in relation to the amount of In in a given product compound. This value can vary, and, in fact, changes in relationship to the amount of time in which the additional element is incorporated in the thin film product. Accordingly, the rejection of the claims is believed obviated.

It is believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.


Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
Norman F. Oblon

Customer Number

22850

Tel: (703) 413-3000
Fax: (703) 413-2220



Frederick D. Vastine
Registration No. 27,013